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16. Abstract Preliminary research was begun during this period. The digital analysis of LANDSAT data on magnetic tapes for identifying forest vegetation and for land use classification was begun. An inventory and cataloging of LANDSAT data holdings at the University of Minnesota was also begun. (E76-10245; ANALYSIS OF DATA FOR LANDSAT (ERTS) FOLLOW-ON Progress Report, 26 Jun. - 25 Sep. 1975 (Minnesota State Planning Agency, St. Paul.) 10 p HC \$3.50 CSCL 05B N76-21629 G3/43 00245 Unclas					
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Figure 2. Technical Report Standard Title Page

20320

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PREFACE

The objectives of the contract are to develop a method of using LANDSAT data that will be reliable enough to be used by resource managers and planners. This method must be economical, easily used and readily available to the users. Secondly, to set up training sessions to acquaint potential users with LANDSAT data. To find out their needs and involve them in the continuing research. This involvement will result in the data collection techniques that will be accepted by the potential users.

The reporting period of this document is from 6/26/75 to 9/25/75. During this time contracts for research were written and the processing of them through internal channels began. In anticipation of final approval of the contract, some work that is introductory in nature was begun by the sub-contractors.

At this time, no significant results or conclusions have been made because of the preliminary nature of the work performed to date.

INTRODUCTION

Objectives of Follow-on investigation #20320 (Contract #NASA-20985)

An inventory and cataloging of the LANDSAT data holdings at the University of Minnesota (Minneapolis and St. Paul campuses) is in preparation for distribution to potential governmental agency users in the state. This catalog will be updated as a serial publication for distribution.

On the basis of a thorough review of the literature, in addition to several years of experience with ERTS data, it was concluded that digital analysis of LANDSAT data on magnetic tapes should be employed in the study of LANDSAT applications to forest vegetation and land use classification in Minnesota. This conclusion was based upon the inability of numerous previous investigations to satisfy the needs of the forest land manager using only bulk imagery in various display forms.

An additional (important) consideration in the conception of this study was the obvious need to involve the man in the field in the determination of the following: (a) data accuracy, and (b) the relative usefulness, under practical conditions of management, of LANDSAT data-based information. A number of forest land managers were asked, and have agreed to participate in the project in the role of "User-Cooperator". All of these individuals have extensive field experience, a high degree of management responsibility, and are well versed in the use of aerial photography, and have been extremely helpful in selecting potential areas for training sets and providing local ground truth data. At such time as the LANDSAT-generated maps of their areas become available, the User-Cooperators will perform trials with them in the field.

This approach is considered to have some significant advantages: (a) evaluation of the accuracy and usefulness of the data will be more valid and have a higher degree of credibility to other potential users because it has been tested by their peers, and (b) it will serve directly and indirectly as a means of orienting and

training field managers in the types and uses of products available.

PROBLEMS

University of Minnesota researchers have been delayed in commencing their contractual work because of internal administrative delays in letting the contract. These internal delays are a part of the normal although lengthy review period that contracts between the State and another party must have.

ACCOMPLISHMENTS

In the March-June 1975 Type II report we reported a problem in needing Health, Education and Welfare (HEW) approval of the form to be used in recording the contractors' share of the cost shared project. HEW, who will be the auditor for this contract, has reviewed the form and has no problem with it. However, HEW has made no formal statement of approval or disapproval.

Two computer tapes were ordered from EROS during this period but as of September 25th, they had not yet arrived.

Two contracts between the State and the University of Minnesota researchers were drawn up and processing was begun. The following items are work done by University of Minnesota contractors in anticipation of the final approval of the contract, and a retroactive starting date.

Regional Development Commission Projects

Meetings have been held with personnel from the Region 4 Development Commission in Fergus Falls, Minnesota and the Arrowhead Regional Development Commission in Duluth (see map 1). The Region 4 RDC is now in a position to utilize quadrangle overlays as an information device to communicate the nature and extent of surface water resource and flooding problems to their county governments.

They anticipate their use as a base for physical planning. They are also interested in developing the capability of reconnaissance monitoring of surface

water quality with LANDSAT materials.

The Arrowhead Regional Development Commission has identified potential LANDSAT applications dealing with mining, land use and water quality, particularly in the mining region of Minnesota. Work has begun on developing mapping procedures for mapping and monitoring extent of iron mining in the area of Aurora and Babbitt, Minnesota.

Applications to Forest Vegetation and Land-Use Classification

All available forest cover type maps in the Itasca County, Minnesota project area were obtained from such local users as the U.S. Forest Service, Minnesota Department of Natural Resources and Blandin Paper Co. were catalogued and filed. These maps will be used in selected training sets and serve as a ground truth base.

The assistance of User-Cooperators from the U.S. Forest Service, Minnesota Department of Natural Resources, Blandin Paper Company, Boise Cascade Paper Company and the Itasca County Land Commissioner's office were enlisted. Samples of satellite imagery were provided and the objectives of the investigation explained. In general, interest appears to be quite high.

The various types and sources of available aerial photography were located, indexed and catalogued.

Much of Itasca County was visited to familiarize the investigators with the vegetation types, land-use patterns, physical and cultural features. A number of relatively pure forest cover types were located and checked for possible use as training sets.

Dr. James A. Smith, a Director of the University Computer Center, Colorado State University, was brought to the University of Minnesota College of Forestry for a week for a series of conferences, seminars, and personal discussions related

to the computer-related aspects of the project plans. As a result of this contact, RECOG, a set of pattern recognition programs for classification of the digital LANDSAT data was obtained from him. Dr. Smith also assisted in making the necessary changes in RECOG so that it could be used in the Minnesota computer system.

Five transformations were performed on the digital data for the scene that had been previously obtained. First, the vertical and horizontal scales were made equivalent so that the resulting size of a resolution element was 79 x 79 mm. Second, the data were rotated so that the array of data was oriented in a north-south manner. Third, due to the earth's rotation while the satellite was recording the measurements for a scene, it was necessary to deskew the data. Fourth, the scale was further transformed to compensate for the difference between the number of lines and columns of symbols printed per inch by the LARS line printer. A final transformation was performed to make the line printer output match standard 1:24,000 scale maps.

Two programs were recently obtained from Colorado State University for reformatting the data for compatibility with RECOG are being altered for implementation on the University of Minnesota computer.

A set of tapes for one scene are being converted to the necessary format for display with a DICOMED film recorder and a method for evaluating the products from it is being developed.

SIGNIFICANT RESULTS

At this time there are no new significant results. There is continual contact with the DICOMED corporation, a producer of color graphics from computer compatible tapes. Refer to March-June Type II report, significant results.

PUBLICATIONS

There were no publications during this reporting period.

DATA USE

In this quarter two computer compatible tapes and a number of image products were ordered from our account at the EROS Data Center in Sioux Falls. The computer compatible tapes were not received in this reporting period. The quality of the imagery received was "good".

In certain instances, the EROS processing time between date of order and date of receipt was quite long. In particular, some imagery ordered on July 3, 1975 of the Red River Valley flood (Minnesota-North Dakota border) was not received until September 4, 1975. This lengthy processing time created a substantial delay in our report to Governor Anderson on the flooding. The Minnesota State Planning Agency is participating in further study of the Red River Valley flood with the EROS Data Center and the State of North Dakota.

In subsequent conversations with EROS personnel, it was understood that they anticipated the order processing time will be considerably shortened for the next reporting period.

<u>Quarter</u>	<u>Value of Data Ordered</u>	<u>Value of Data Received</u>	<u>Value of Outstanding Orders at end of quarter</u>
3/25-6/25/75	\$ 224.00	\$ 56.00	\$168.00
6/26-9/25/75	1,374.00	1,142.00	232.00

Please note that the value of LANDSAT standing account #G20320 was changed from \$6,700.00 to \$11,500.00 effective September 18, 1975. (Letter attached.)

FUNDS EXPENDED

The amount of money expended this quarter was minimal, due to contract problems previously discussed. Those funds that were expended other than for data collection were the coordinators salary and expenses.

<u>Travel expenses, NASA Coordinator</u>		<u>Salary, NASA Coordinator</u>		
June 26-30	\$ 0	June 26-30	\$	* (Contractor's
July 1-31	13.91	July 1-31	724.30	Share)
August 1-31	40.80	August 1-31	533.52	
September 1-25	40.97	September 1-25	477.36	
	<hr/>		<hr/>	
TOTAL	\$95.68	TOTAL	\$1,735.18	

RECOMMENDATIONS

We plan to coordinate an informational seminar-like meeting that introduces LANDSAT, its imagery, and EROS to state and regional level public agency employees. The meeting will occur in the next reporting period.

PROPOSED WORK FOR NEXT QUARTER

A sample of quadrangle overlays for Region 3 and 4 Regional Development Commissions will be completed for their staff's evaluation and suggested modifications or approval. The definition of study areas and methodologies for reconnaissance analysis of surface water quality will also be developed in the next reporting period.

Line printer "gray maps" will be generated for selected areas in Itasca County.

The accuracy of the geometric connection will be evaluated. Inconsistencies in scale and orientation of the computer-displayed LANDSAT data will be noted.



United States Department of the Interior

GEOLOGICAL SURVEY
EROS Data Center
Sioux Falls, South Dakota 57198

IN REPLY REFER TO: Standing Account
#G20320

September 18, 1975

Mr. Joseph E. Sizer
Minn. State Planning Agency
802 Capitol Square Building
St. Paul, MN 55101

Dear Mr. Sizer:

Your Technical Monitor at Goddard Space Flight Center has requested the following update(s):

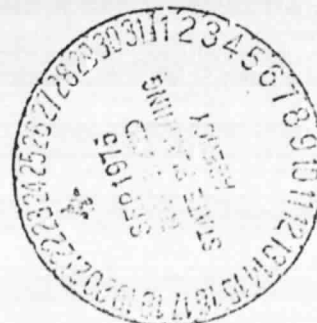
LANDSAT Standing Account #G20320
Budget changed from \$6,700.00 to \$11,500.00;
Net increase of \$4,800.00

The above update(s) are effective as of September 18, 1975. All other specifications remain the same.

If you have any questions, please feel free to contact us.

Sincerely,

Leo A. Braconnier
Acting Chief, User Services



Signatures will be extracted for several natural resource cover types from selected training sets, using cover type maps as ground truth.

These signatures will be used to train a statistical decision algorithm (Gaussian likelihood ratio) for performing a supervised classification of both training and test areas using all four spectral bands of LANDSAT data.

Classification accuracies will be determined on both the training and test sets. The confusion in classification between cover types will be considered in determining which types will be possible to map.

CONCLUSIONS

The movement of contracts between the State and other researchers from the negotiation stage to processing allowed preliminary work to begin during this quarter. Work begun consisted of two parts. The first was steps to implement the digital analysis of LANDSAT data on magnetic tapes for identifying forest vegetation and for land use classification. The second part consists of beginning an inventory and cataloguing of LANDSAT data holdings at the University of Minnesota's Minneapolis and St. Paul campuses.